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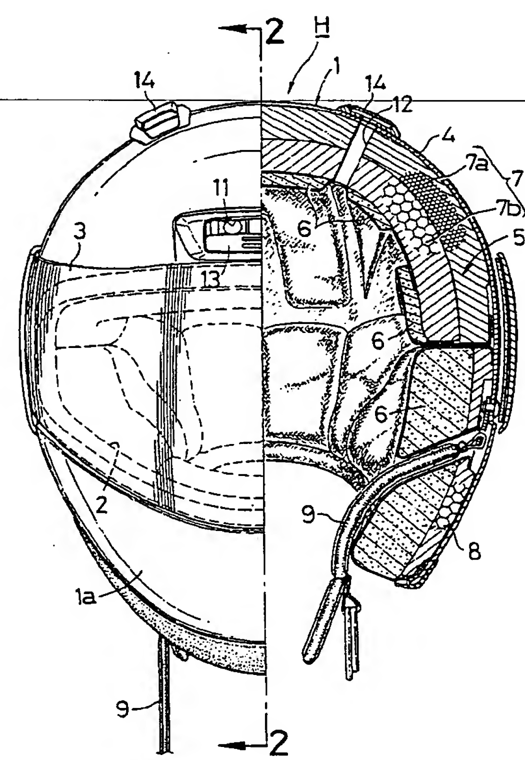
(54) Cap body of a helmet

(57) In a cap body (1) of a helmet (H) comprised of a shell (4) and a liner (7), the liner (7) includes an outer liner (7a) made of a low expanded synthetic resin and having an excellent external force dispersing function, and an inner liner (7b) made of a high expanded synthetic resin and having an excellent external force absorbing function, said inner liner (7b) being fitted to an inner surface of said outer liner (7a). Thus, the shock damping performance of the cap body (1) can be enhanced without specially increasing the thickness of the liner (7).

FIG. 1



EP 0 770 338 A1

Description

The present invention relates to a cap body of a helmet used by a rider on a motorcycle or driver of a motor vehicle and particularly, to an improvement in a cap body of a helmet including a shell and a liner made of an foamed or expanded synthetic resin fitted to an inner surface of the shell.

The cap body of such structure, when it receives a shock force, disperses the shock force into a wide range by a high rigidity of the shell to reduce the pressure applied to the liner to the utmost, and absorbs such pressure by the compression deformation of the liner to exhibit a shock damping performance. To enhance the shock damping performance, it is a conventional practice to increase the thickness of the liner.

However, if the thickness of the liner is increased, the shell is inevitably increased in size and thus, the cap body is also inevitably increased in size.

Accordingly, it is an object of the present invention at least in its preferred forms to provide a cap body of a helmet of the above-described type, wherein an enhancement in shock damping performance can be provided without specially increasing the thickness of the liner.

According to the invention, there is provided a cap body of a helmet comprising a shell, and a liner made of a foamed or expanded synthetic resin and disposed inside said shell, wherein said liner is comprised of an outer liner made of a low expanded synthetic resin disposed inside said shell, and an inner liner made of a high expanded synthetic resin and disposed inside said outer liner.

With the above first feature, the shock damping performance of the cap body can be enhanced without specifically increasing the thickness of the liner and thus while avoiding an increase in cap body. In addition, each of the outer and inner liners is small in thickness alone and relatively easily deformed and hence, the outer and inner liners can be easily fitted sequentially even to the shell having an opening constricted, leading to an enhanced assembleability. Further, by preparing several types of inner liners having different inner sizes and combining outer liners having the same size, several types of cap bodies having different sizes can be easily produced to contribute to a reduction in cost.

The specific gravity of said outer liner is preferably significantly higher than that of the said inner liner. It is particularly preferred for a specific gravity ρa of said outer liner is larger than 0.06133, and a specific gravity ρb of said inner liner is smaller than 0.0648.

With this feature, a good external force dispersing function can be reliably provided to the outer liner, and a good external force absorbing function can be reliably provided to the inner liner.

Preferably an outer size of said inner liner is set at the same value as, or at a value larger than an inside size of said outer liner.

With this feature, when the inner liner is press-fitted into the outer liner, the opposed-surfaces of the shell and the outer and inner liners can be brought into close contact with one another by a wedge effect of the inner liner on the outer liner, thereby preventing a looseness of the liner within the shell.

In preferred embodiments of the invention said liner includes a decreased-thickness section which is decreased in thickness toward a lower end of the liner, said inner liner is formed, at a lower portion thereof in a region of said decreased-thickness section, with an outward projecting stepped portion, and a lower end face of said outer liner abuts against an upper surface of said stepped portion, or is opposed to said upper surface of said stepped portion.

With this feature, an extreme decrease in individual thickness of the inner and outer liners in the decreased-thickness section can be inhibited,thereby preventing a reduction in strength of each liner due to an excessive decrease in thickness.

Alternatively, in addition to the previously mentioned features said liner preferably includes a decreased-thickness section which is decreased in thickness toward a lower end of the liner, a lower end of said outer liner is terminated at a location above a lower end of said inner liner in a region of said decreased-thickness section, and outer surfaces of said inner and outer liners are formed so as to be substantially continuous to each other.

Even with this feature, a reduction in strength due to an excessive decrease in thickness of each liner can be prevented.

Certain embodiments of the invention will now be described by way of example only and with reference to the accompanying drawings:-

Fig.1 is a partially vertical sectional front view of a full-face type helmet including a cap body according to a first embodiment of the present invention;
Fig.2 is a sectional view taken along a line in Fig.2;
Fig.3 is an exploded perspective view of a liner of the helmet;
Fig. 4 is a side view of a main liner;
Fig.5 is a sectional view taken along a line 5-5 in Fig.4;
Fig.6 is a partially sectional front view of a jet-type helmet including a cap body according to a second embodiment of the present invention;

Fig.7 is a sectional view taken along a line 7-7 in Fig.6;
Fig.8 is an exploded perspective view of a liner;
Fig.9 is a side view of the liner;
Fig.10 is a partially sectional front view of a full-face type helmet including a cap body according to a third embodiment of the present invention;
Fig.11 is an exploded perspective view of the helmet;
Fig.12 is a sectional view similar to Fig.10, but illustrating a full-face type helmet according to a fourth embodiment of the present invention;
Fig.13 is a sectional view similar to Fig.10, but illustrating a full-face type helmet according to a fifth embodiment of the present invention; and
Fig.14 is a sectional view similar to Fig.10, but illustrating a full-face type helmet according to a sixth embodiment of the present invention.

First, a first embodiment of the present invention will be described with reference to Figs.1 to 5.

Referring to Figs.1 and 2, a full-face type helmet H is used in riding on a motorcycle and includes a cap body 1 having a chin covering portion la located immediately below a window opening 2 in a front surface, and a shield 3 pivotally supported on left and right opposite sidewalls of the cap body 1 to open and close the window opening.

The cap body 1 includes a shell 4 made by an injection molding from a synthetic resin, and a liner 5 made of a foamed synthetic resin and mounted to an inner surface of the shell 4. Soft pads 6 are mounted to an inner surface of the liner 5 at suitable places. A chin belt 9 is riveted to the shell 4.

As shown in Figs.2 and 3, the liner 5 is divided into a main liner 7 according to the present invention and mounted to an inner surface of a dome-shaped main portion of the shell 4, and a chin liner 8 mounted to an inner surface of the chin cover la in the shell 4. The main liner 7 is divided into an outer liner 7a fitted to the inner surface of the shell 4, and an inner liner 7b fitted to an inner surface of the outer liner 7a. The shell 4 and the outer liner 7a as well as the outer liner 7a and the inner liner 7b are bonded to each other respectively by an adhesive in a bonding area A in rear of a second ventilation bore 12 which will be described hereinafter.

During molding of the outer liner 7a, a relatively low expansion ratio is applied to the outer liner 7a, so that the specific gravity ρa thereof exceeds 0.0613. During molding of the inner liner 7b, a relatively high expansion ratio is applied to the inner liner 7b, so that the specific gravity ρb thereof is smaller than 0.0648. The specific gravity values ρa and ρb are set to satisfy $\rho a/\rho b \geq 1.111$.

The outer size of the inner liner 7b is set at the same value as or at a value slightly larger than the inner size of the outer liner 7a.

The followings are examples of suitable raw materials which can be used for the shell 4: PP (polypropylene), A/EPDM/S (acrylonitrile/ethylene-propylene-dien/styrene), PA (polyamide), ABS resin, FRP, PC (polycarbonate), PET (polyethylene terephthalate), PS and the like. As to the liner 5, the followings can be used as raw materials: PP, PS, a polyvinylidene chloride, ABS resin, PE (polyethylene), A/EPDM/S, PA and the like.

Specified examples of the raw materials for the outer and inner liners 7a and 7b are given in Table 1 below.

Table 1

Specified example	Outer liner 7a	Inner liner 7b
1	lowly expanded PP	highly expanded PP
2	lowly expanded PS	highly expanded PS
3	lowly expanded PP	highly expanded PS
4	lowly expanded PS	highly expanded PP
PP : polypropylene PS : polystyrene		

A single or a plurality of first ventilation bores 11 arranged laterally are provided in a front wall of the cap body 1 to penetrate the front wall, and a single or a plurality of second ventilation bores 12 arranged laterally are provided in an upper wall of the cap body 1 to penetrate the upper wall. A shutter 13 is mounted to the shell 4 for opening and closing the first ventilation bores 11, and a control plate 14 is also mounted to the shell 4 and capable of selectively applying a dynamic pressure or a negative pressure of travel wind to the second ventilation bores 12 during traveling of the motorcycle.

The outer liner 7a and the inner liner 7b have no undercut provided at the inner surface of an lower opening and hence, the rapping after molding thereof is facilitated. On the other hand, the shell 4 has an undercut provided at the

inner surface of an lower opening, namely, the opening is slightly constricted and hence, in the case of the full-face type, the thickness of the side of the main liner 7 at a location to the rear is necessarily decreased toward the lower end. In such decreased-thickness portion 7r, a stepped portion 15 projecting outwards is formed at the lower end of the inner liner 7b, and the outer liner 7a is formed so that the lower end face of the outer liner 7a abuts against an upper surface of the stepped portion, or is opposed to the upper surface of the stepped portion at a very small clearance left therebetween.

The operation of the embodiment will be described below.

If an shock force is applied to the cap body 1 of the helmet H according to the present invention, the shock force is first dispersed to a wide range due to a high rigidity of the shell 4 and transmitted to the outer liner 7a. The outer liner 7a is made of a foamed or expanded synthetic resin and has a specific gravity set a relatively high value exceeding 0.06133. Therefore, the shock force received from the shell 4 is further dispersed to a wider range while being suitably absorbed, and transmitted. In this manner, the shock force is dispersed and absorbed over two stages and hence, the pressure applied to the inner liner 7b is lower, and the inner liner 7b made of a high foamed or expanded synthetic resin having a specific gravity of 0.0648 effectively absorbs such pressure while being easily compressed and deformed. Thus, the shock damping performance can be exhibited without specially increasing the thickness of the liner 2, thereby protecting the user's head against the shock force.

The reason why the specific gravity of the outer liner 7a is defined to exceed 0.06133 is that if the specific gravity is equal to or lower than 0.06133, the hardness of the outer liner 7a is too low and hence, a required external force dispersing function is not obtained. The reason why the specific gravity of the inner liner 7b is defined to be lower than 0.0648 is that if the specific gravity is equal to or higher than 0.0648, the hardness of the inner liner 7a is too high and hence, an external force absorbing function is sufficiently not obtained.

In the specified example 1 in above Table, each of the expanded PPs forming the outer and inner liners 7a and 7b has a relatively stable compression strength and hardness even at higher and lower temperatures. Therefore, in any of higher and lower temperature states, the outer liner 7a can exhibit an intended external force dispersing function, and the inner liner 7b can exhibit an intended external force absorbing function. As a whole, a good shock damping performance can be obtained.

In the specified example 2, each of the foamed or expanded PSs forming the outer and inner liners 7a and 7b can maintain a sufficient compression strength and a moderate hardness even at a higher temperature and on the other hand, the hardness of the inner liner is higher at a lower temperature. In the higher temperature state, good external force dispersing and absorbing functions can be exhibited, but in the lower temperature state, the external force absorbing function is less enhanced.

In the specified example 3, the low expanded PP forming the outer liner 7a has a relatively stable compression strength at lower and higher temperatures and can always exhibit a good external force dispersing performance, but the high expanded PS forming the inner liner 7b tends to be increased in hardness at a lower temperature.

In the specified example 4, the low expanded PS forming the outer liner 7a is excellent in external force dispersing function at higher and lower temperatures, and the high expanded PP forming the inner liner 7b exhibits constantly stable external force absorbing function at higher and lower temperatures. Therefore, as a whole, a good shock damping performance can be obtained in any of the higher and lower temperature states.

The expanded PP is high in deformation restorability, as compared with the expanded PS.

In assembling the cap body 1, the outer liner 7a is first fitted alone to the inner surface of the shell 4 and bonded in the above-described bonding area A. Then, the inner liner 7b is press-fitted to the inner surface of the outer liner 7a and bonded in such bonding area A. Thus, each of the outer and inner liners 7a and 7b individually has a small thickness and is relatively easily deformed. Therefore, the outer and inner liners 7a and 7b can be simply fitted even to shell 4 having the lower opening constricted, and the adhesive can be prevented to entering the second ventilation bore 12. Moreover, since the outer size of the inner liner 7b is set at the same value as, or at the larger value than the inner size of the outer liner 7a, the inner liner 7b can exhibit a wedge effect to the outer liner 7a during press-fitting to bring the opposed surface of the shell 4 and the outer and inner liners 7a and 7b into close contact with one another, thereby preventing the looseness of the main liner 7.

The fitted portions of the inner and outer liners 7b and 7a are high in air-tightness, but since the first and second ventilation bores 11 and 12 are provided in both the inner and outer liners 7b and 7a, they serve as air vent bores, so that the fitting of the inner and outer liners 7b and 7a can be smoothly and tightly performed. Moreover, the second ventilation hole 12 in the upper wall of the cap body 1 extends in a direction of fitting of the shell and the outer and inner liners 7a and 7b and hence, during fitting of them, the three members 4, 7a and 7b can be easily and reliably fitted together at a fixed position by the previous insertion of the positioning pin 9 into the second ventilation bore(s) 12 from the side of the shell 4, as shown in Fig.2.

Further, various types of cap bodies 1 having different sizes can be easily produced only by preparing various types of inner liners 7b having different inside sizes and combining these inner liners 7b with outer liners 7a having the same size.

Yet further, since the stepped portion 15 projecting outwards is formed at the lower end of the inner liner 7b in a region of the decreased-thickness portion 7r of the inner liner 7b, and the lower end face of the outer liner 7a is located to abut against, or is opposed to the upper surface of the stepped portion 15, the individual thickness of the inner and outer liners 7b and 7a is not required to be extremely decreased and hence, a reduction in strength of the lower end of each of the liners 7a and 7b due to an excessive decrease in thickness can be prevented.

A second embodiment of the present invention will now be described with reference to Figs.6 to 9.

A helmet H in the second embodiment is also used for riding on a motorcycle and includes a cap body 1 which has an opened lower edge of a window opening 2, i.e., does not include a chin cover la as provided in the previous embodiment. The liner 7 of the cap body 1 is divided into an outer liner 7a which is fitted to an inner surface of a shell 4 as is the main liner 7 in the previous embodiment, and an inner liner 7b which is fitted to an inner surface of the outer liner 7a.

In the second embodiment, the outer liner 7a is made of a low expanded polyvinylidene chloride, and the inner liner 7b is made of a high expanded polyvinylidene chloride. Thus, the heat insulating property and the mechanical property of each of the liners 7a and 7b can be stable irrespective of a change in temperature.

A rear wall of the liner 7 is provided with a decreased-thickness portion 7r decreased in thickness toward a lower end. In the decreased-thickness portion 7r, a lower end of the outer liner 7a is terminated at above a lower end of the inner liner 7b, and outer surfaces of the outer and inner liners 7a and 7b are formed so that they are continuous to each other and fitted to the inner surface of the shell 4. With such a construction, it is possible to inhibit an extreme decrease in individual thickness of the inner and outer liners 7b and 7a in the decreased-thickness portion 7r, and to prevent a reduction in strength of the liners 7a and 7b due to an excessive decrease in thickness.

The other constructions are substantially the same as in the previous embodiment, and in Figures, portions or components corresponding to those in the previous embodiment are designated by like reference characters.

A third embodiment of the present invention will now be described with reference to Figs.10 and 11.

A cap body 1 of a helmet according to the third embodiment has arrangement basically similar to that in the first embodiment, except that an auxiliary shell 20 is closely interposed between outer and inner liners 7a and 7b. In Figures, portions or components corresponding to those in the first embodiment are designated by like reference characters.

The auxiliary shell 20 is made by an injection molding from a synthetic resin similar to or different from a material for the main shell 4, but is formed at smaller thickness and weight than those of the main shell 4 and has a moderate flexibility.

In the helmet in this embodiment, even if a pointed projection crashes against an outer surface of the cap body 1 to break through the main shell 4, the breaking of the main shell 4 cannot spread into the auxiliary shell 20, because the auxiliary shell 20 is spaced apart from the main shell 4. Moreover, the projection consuming much energy by breaking through the main shell 4 applies a compression deformation to the outer liner 7a, or breaks the outer liner 7a, and further strikes the auxiliary shell 20, thereby releasing a remaining energy. By effectively absorbing the crash energy of the projection in this manner, the penetration of the projection through the cap body 1 can be inhibited, and the penetration resistance of the cap body is increased remarkably, as compared with an integrated shell having a thickness equal to a total thickness of the main and auxiliary shells 4 and 20.

An shock force applied from the projection is dispersed into a wide range sequentially by the main shell 4, the outer liner 7a and the auxiliary shell 20, thereby weakening the pressure. Therefore, the shock force can be reliably absorbed by the compression deformation of the inner liner 7b made of the high expanded synthetic resin.

Fig.12 illustrates a fourth embodiment of the present invention. A bond portion 21 contacting with an inner surface of a main shell 4 is connected to a peripheral edge of an auxiliary shell 20 through an inclined portion 22 and bonded to the main shell 4 by a rivet or an adhesive. The other constructions are similar to those in the previous embodiments, and in Fig.12, portions or components corresponding to those in the previous embodiments are designated by like reference characters.

According to the fourth embodiment, the auxiliary shell 20 is reinforced in rigidity by the fact that it is coupled to the main shell 4. Therefore, it is possible to provide a reduction in thickness of the auxiliary shell 20 to contribute to reductions in thickness and weight of the cap body 1.

In addition, the inclined portion 22 of the auxiliary shell 20 is deformable upon application of an shock force to the cap body 1 and hence, does not impede the shock absorbing function of the outer and inner liners 7a and 7b.

Fig.13 illustrates a fifth embodiment of the present invention, which is of a construction similar to that in the third embodiment, except that a high-strength fabric made of an aramide resin fiber or the like is interposed between the main shell 4 and the outer liner 7a. In Fig.13, portions or components corresponding to those in the third embodiment are designated by like reference characters.

According to the fifth embodiment, the high-strength fabric exhibits a strong resisting force against the penetration of a projection and hence, the penetration resistance of the cap body 1 can be enhanced without little increasing the thickness of the cap body 1 and particularly the thickness of the main shell 4.

Fig.14 illustrates a sixth embodiment of the present invention. A helmet H according to the sixth embodiment has

the basically same construction as in the first embodiment, except that a shell r of a cap body includes an outer shell 4a and an inner shell 4b superposed on an inner surface of the outer shell 4a. In Fig.14, portions or components corresponding to those in the sixth embodiment are designated by like reference characters.

The outer shell 4a and the inner shell 4b are formed of a material similar to that for the shell 1 in the first embodiment, but the thicknesses of the outer shell 4a and the inner shell 4b may be equal to or different from each other.

According to the sixth embodiment, even if the outer shell 4a is broken by crashing of a projection thereagainst, the breaking does not spread to the inner shell 4b. Therefore, the penetration resistance of the shell 4 can be enhanced by cooperation of both the shells 4a and 4b. Moreover, such penetration resistance is higher than that of an integrated shell having a thickness equal to a total thickness of the shells 4a and 4b.

A shock force applied to the outer shell 4a is dispersed into a wide range sequentially by the inner shell 4b and the outer liner 7a, thereby sufficiently reducing the pressure and is then absorbed by the inner liner 7b. Because the shock force is absorbed in the wide range in this manner, the shock damping function can be enhanced without specially increasing the thickness of the main liner 7.

The present invention is not limited, and various modifications in design may be made without departing from the subject matter and scope of the invention defined in claims.

For example, the materials for the outer and inner liners in the second embodiment may be also used for forming the outer and inner liners in the first embodiment and the other embodiments. Conversely, the materials for the outer and inner liners in the first embodiment and the other embodiments may be used for forming the outer and inner liners in the second embodiment.

Claims

1. A cap body of a helmet comprising a shell, and a liner made of a foamed or expanded synthetic resin and disposed inside said shell, wherein said liner is comprised of an outer liner made of a low expanded synthetic resin and an inner liner made of a high expanded synthetic resin disposed within said outer liner.

2. A cap body of a helmet according to claim 1, wherein a specific gravity ρa of said outer liner is larger than 0.06133, and a specific gravity ρb of said inner liner is smaller than 0.0648.

3. A cap body of a helmet according to claim 1 or 2, wherein an outer size of said inner liner is set at the same value as, or at a value larger than an inside size of said outer liner.

4. A cap body of a helmet according to claim 1, 2 or 3, wherein said liner includes a decreased-thickness section which is decreased in thickness toward a lower end of the liner, said inner liner is formed, at a lower portion thereof in a region of said decreased-thickness section, with an outward projecting stepped portion, and a lower end face of said outer liner abuts against an upper surface of said stepped portion, or is opposed to said upper surface of said stepped portion.

5. A cap body of a helmet according to claim 1, 2 or 3, wherein said liner includes a decreased-thickness section which is decreased in thickness toward a lower end of the liner, a lower end of said outer liner is terminated at a location above a lower end of said inner liner in a region of said decreased-thickness section, and outer surfaces of said inner and outer liners are formed so as to be substantially continuous to each other.

6. A cap body of a helmet according to any of claims 1 to 5, further including an auxiliary shell interposed in a close contact state between said outer and inner liners.

7. A cap body of a helmet according to claim 6, wherein a peripheral edge of said auxiliary shell is coupled to an outermost main shell.

8. A cap body of a helmet according to any of claims 1 to 7, further including a high-strength fabric interposed between the fitted surfaces of said shell and said outer liner.

9. A cap body of a helmet according to any of claims 1 to 5, wherein said shell is comprised of an outer shell and an inner shell superposed on said outer shell.

10. A cap body of a helmet according to any of claims 1 to 9, wherein said outer liner is made of a low expanded polypropylene, and said inner liner is made of a high expanded polypropylene.

11. A cap body of a helmet according to any of claims 1 to 9, wherein said outer liner is made of a low expanded polystyrene, and said inner liner is made of a high expanded polystyrene.

12. A cap body of a helmet according to any of claims 1 to 9, wherein said outer liner is made of a low expanded polypropylene, and said inner liner is made of a high expanded polystyrene.

13. A cap body of a helmet according to any of claims 1 to 9, wherein said outer liner is made of a low expanded polystyrene, and said inner liner is made of a high expanded polypropylene.

14. A cap body of a helmet according to any of claims 1 to 9, wherein said outer liner is made of a low expanded polyvinylidene chloride based resin, and said inner liner is made of a high expanded polyvinylidene chloride based resin.

FIG.1

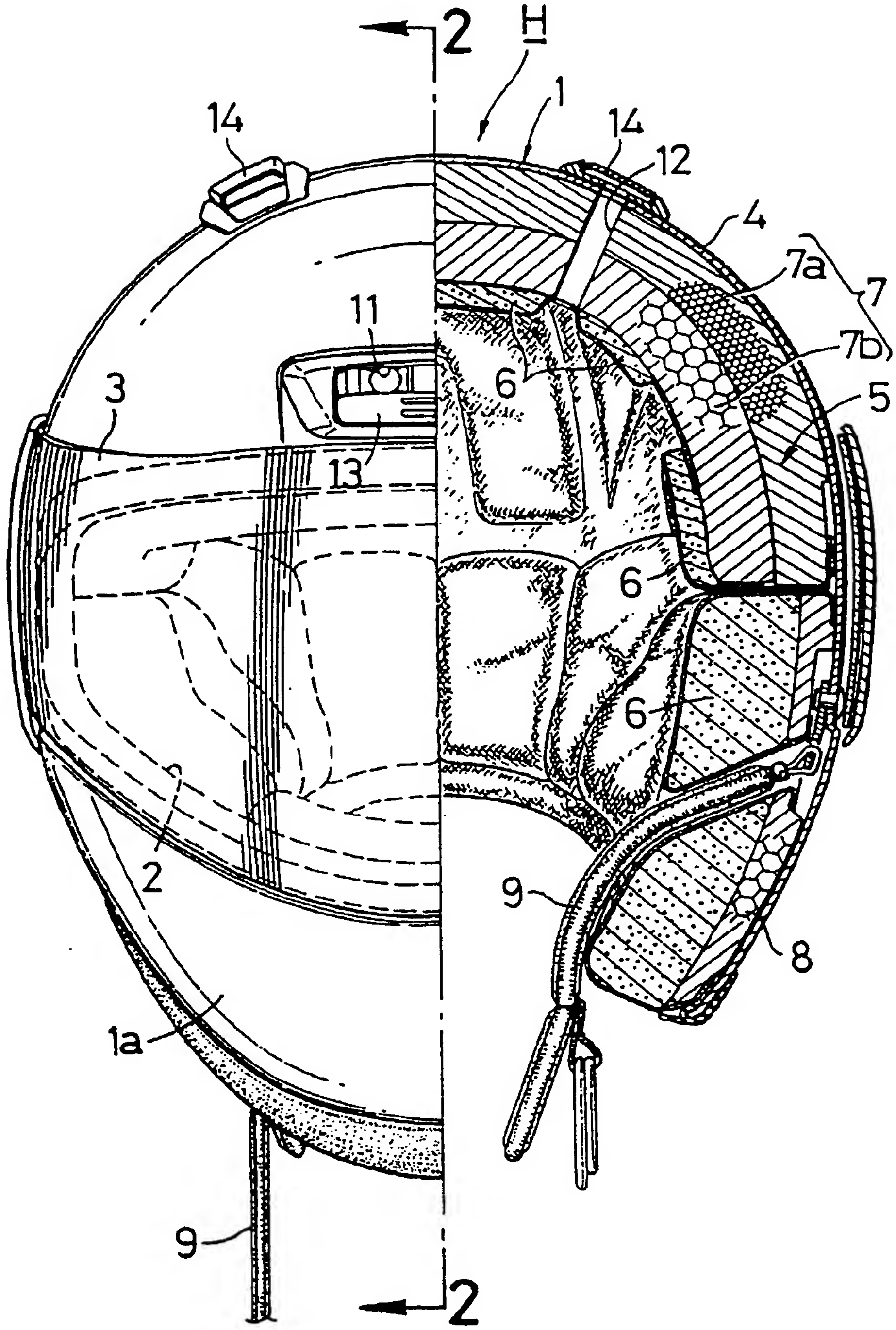


FIG. 2

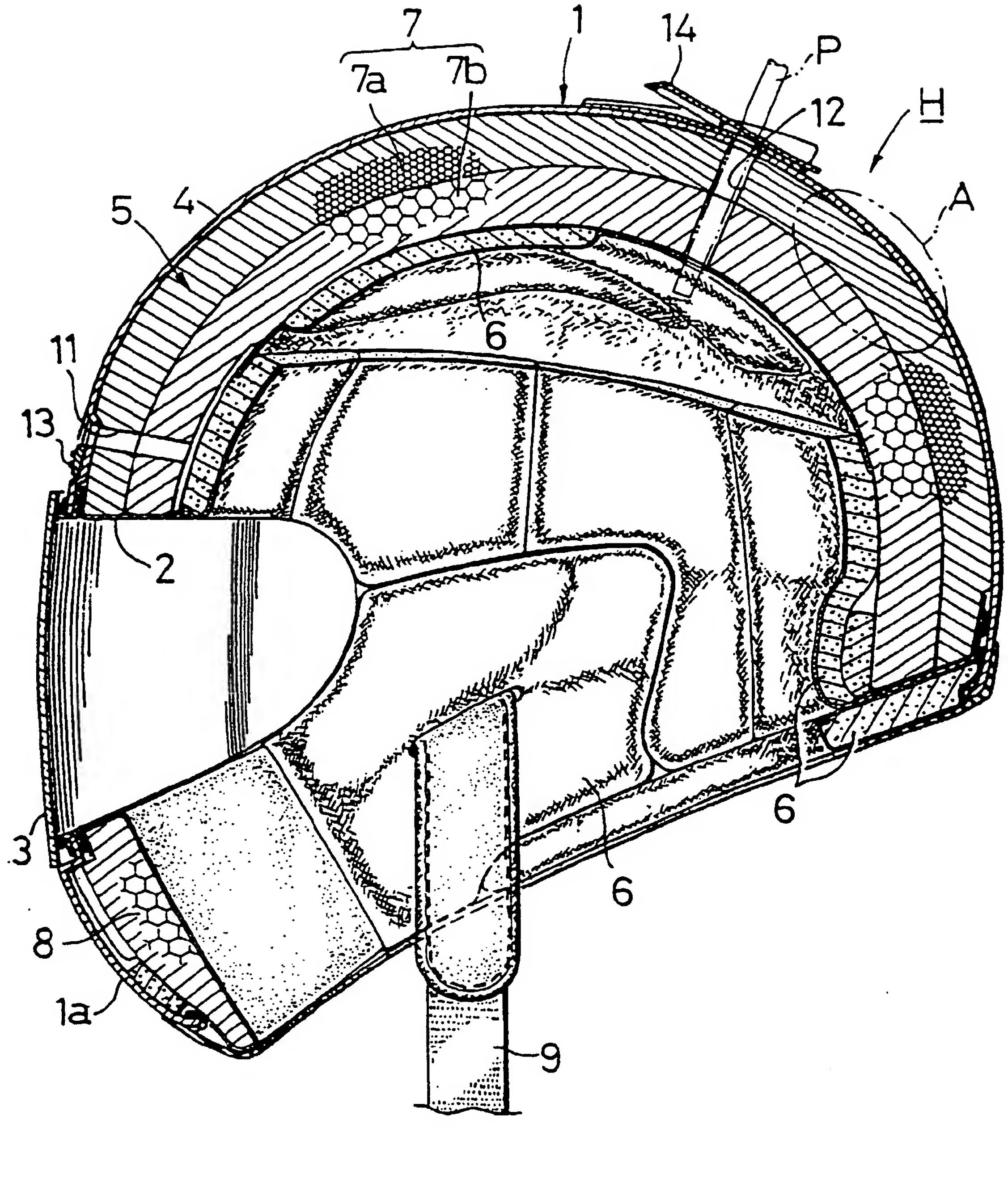


FIG.3

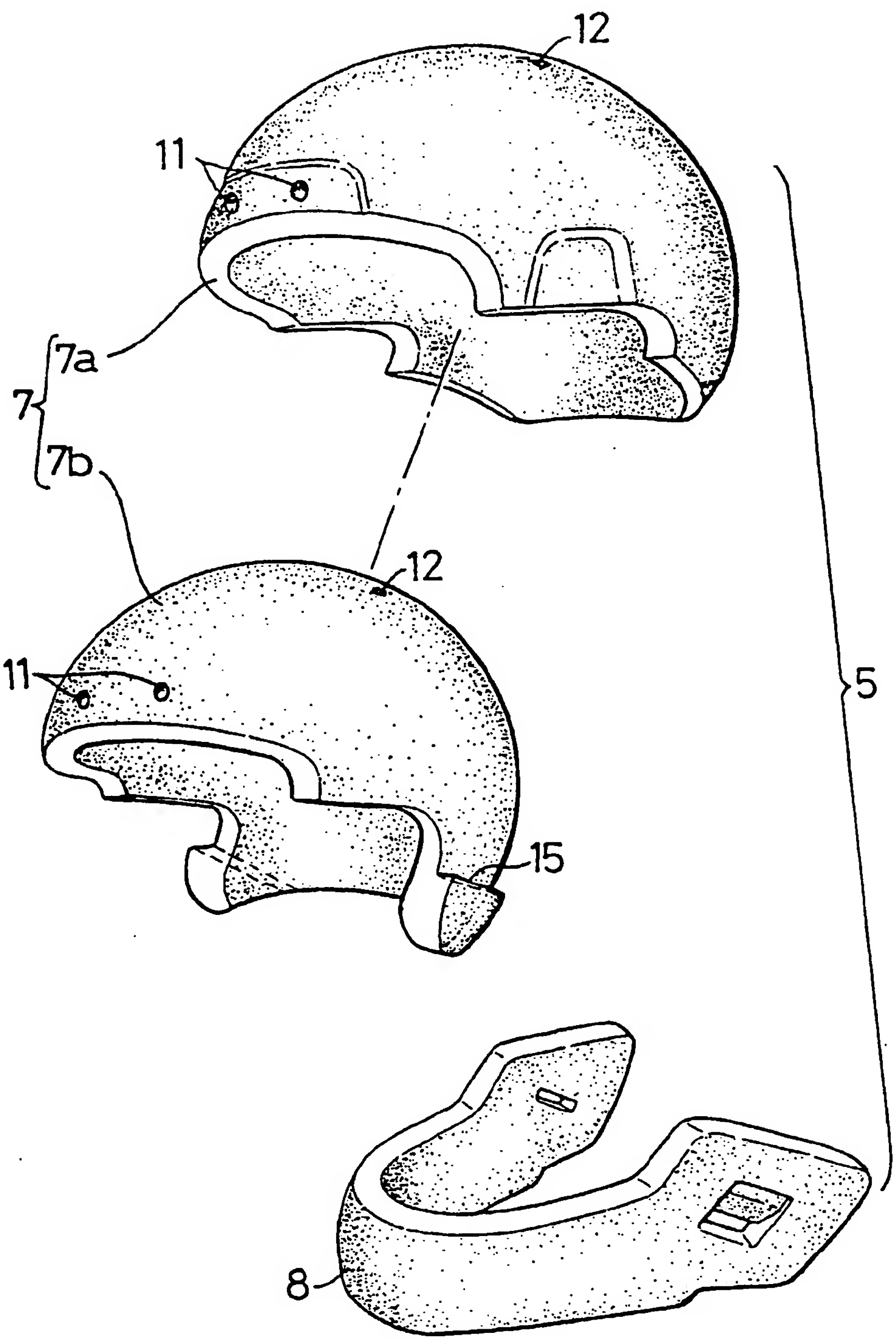


FIG.4

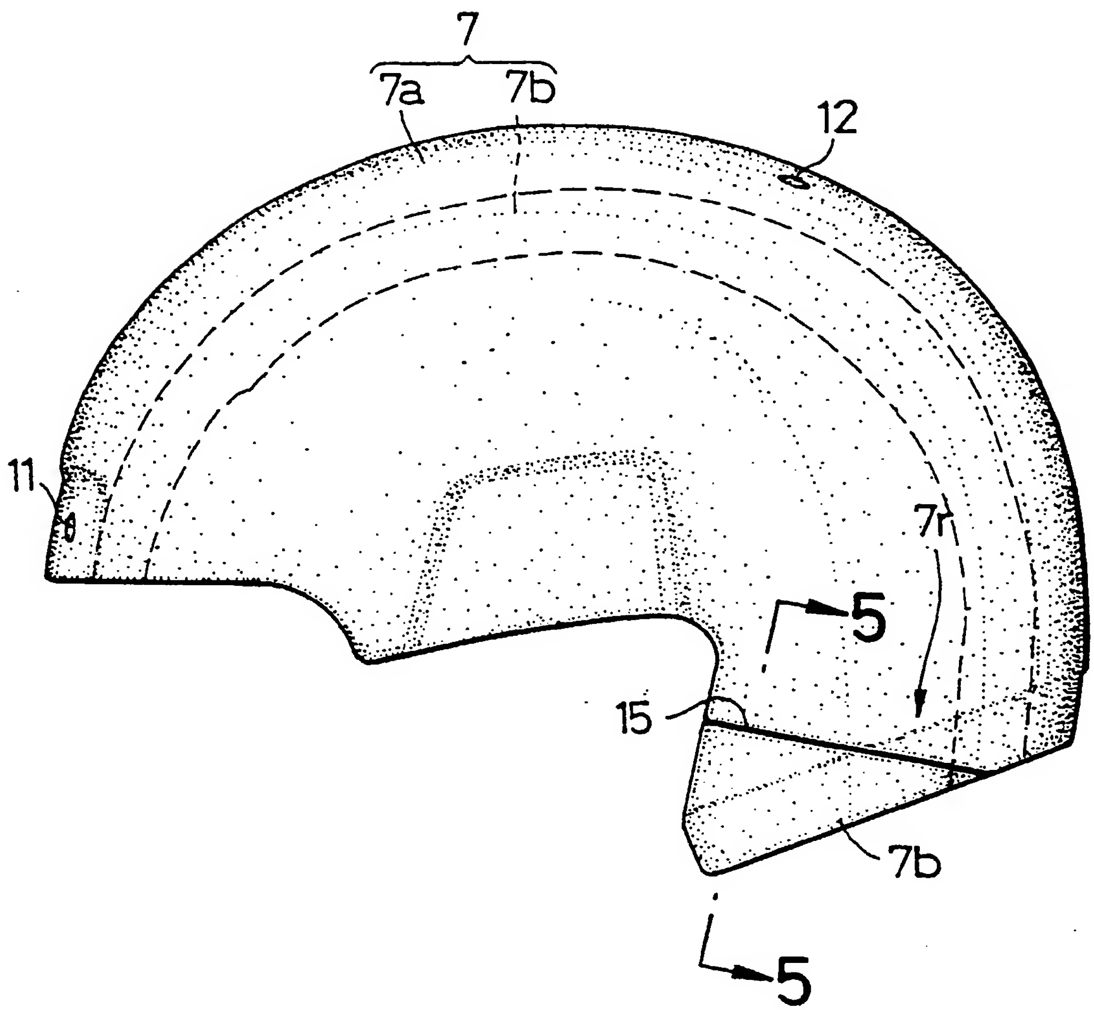


FIG.5

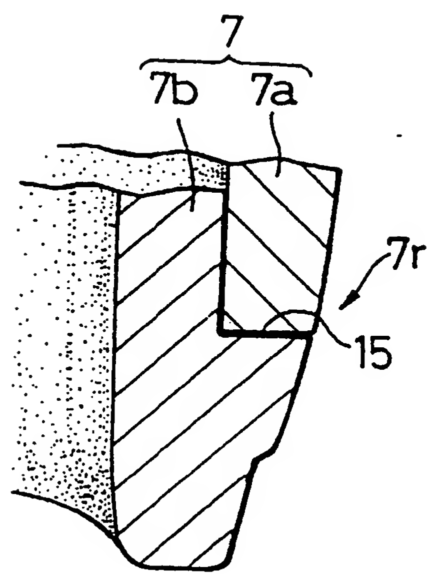


FIG.6

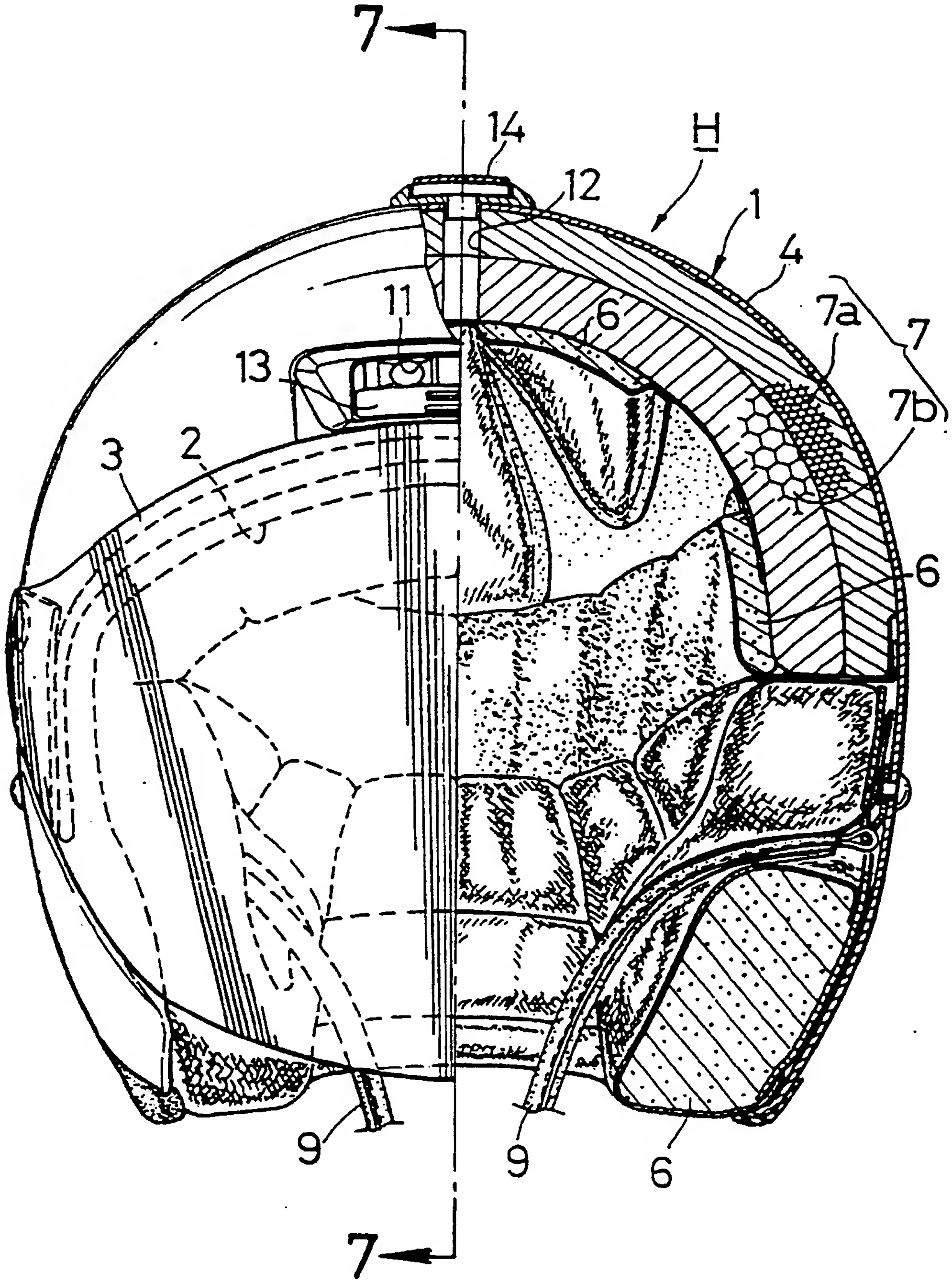


FIG.7

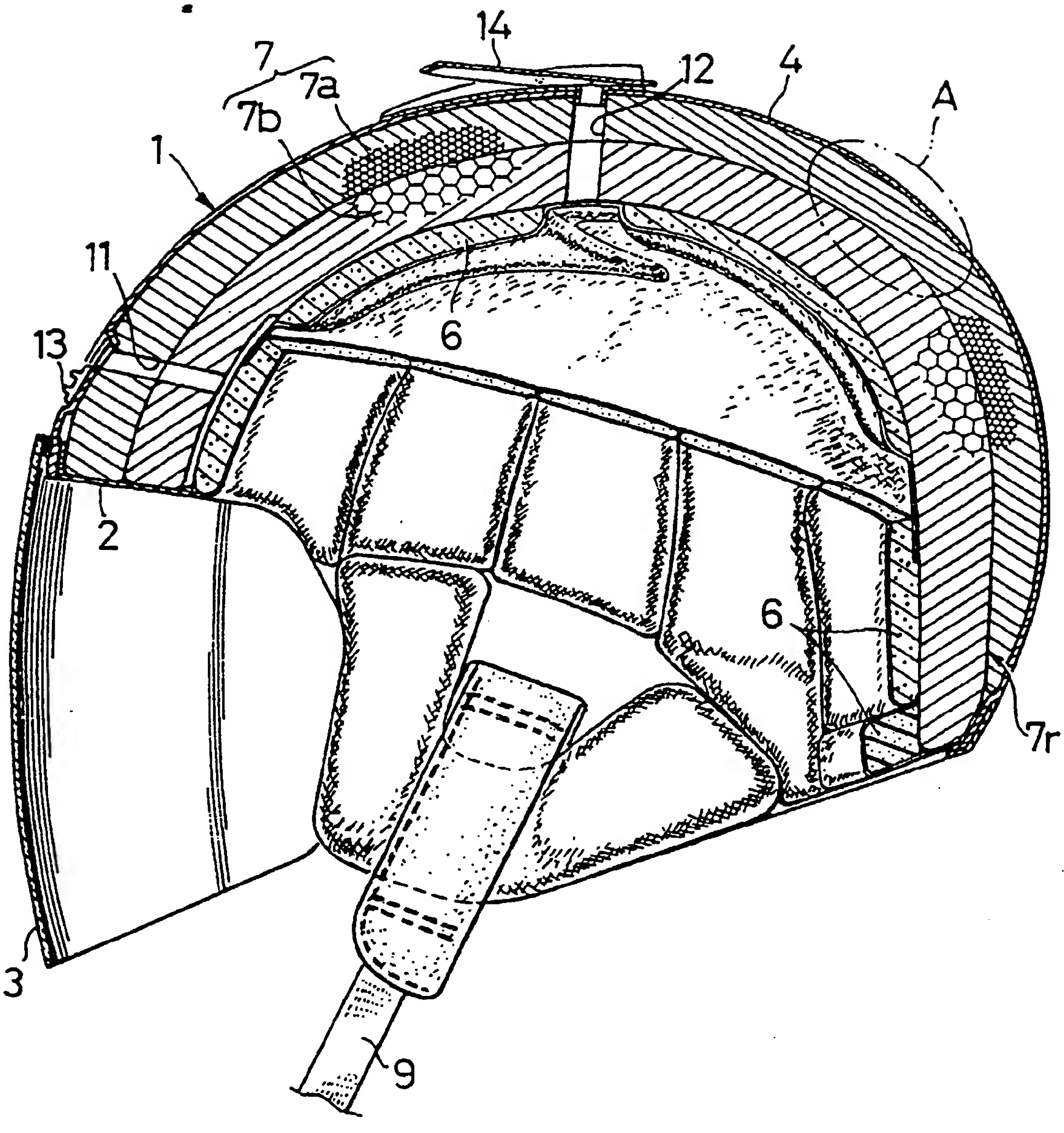


FIG.8

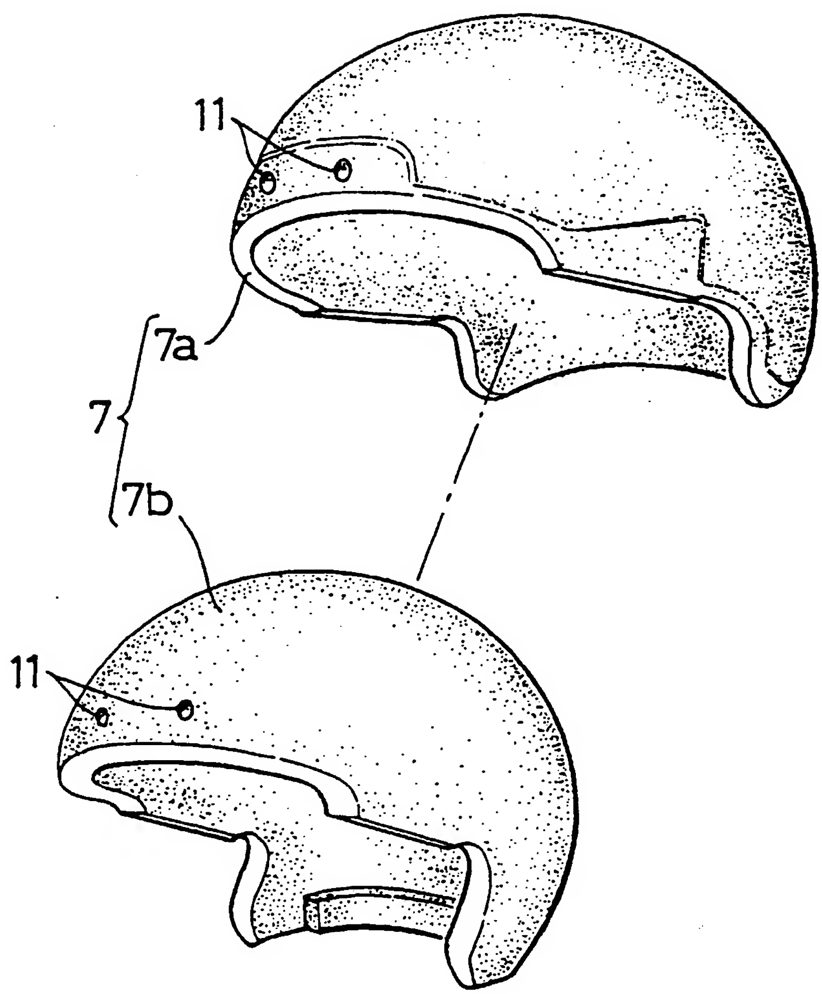


FIG.9

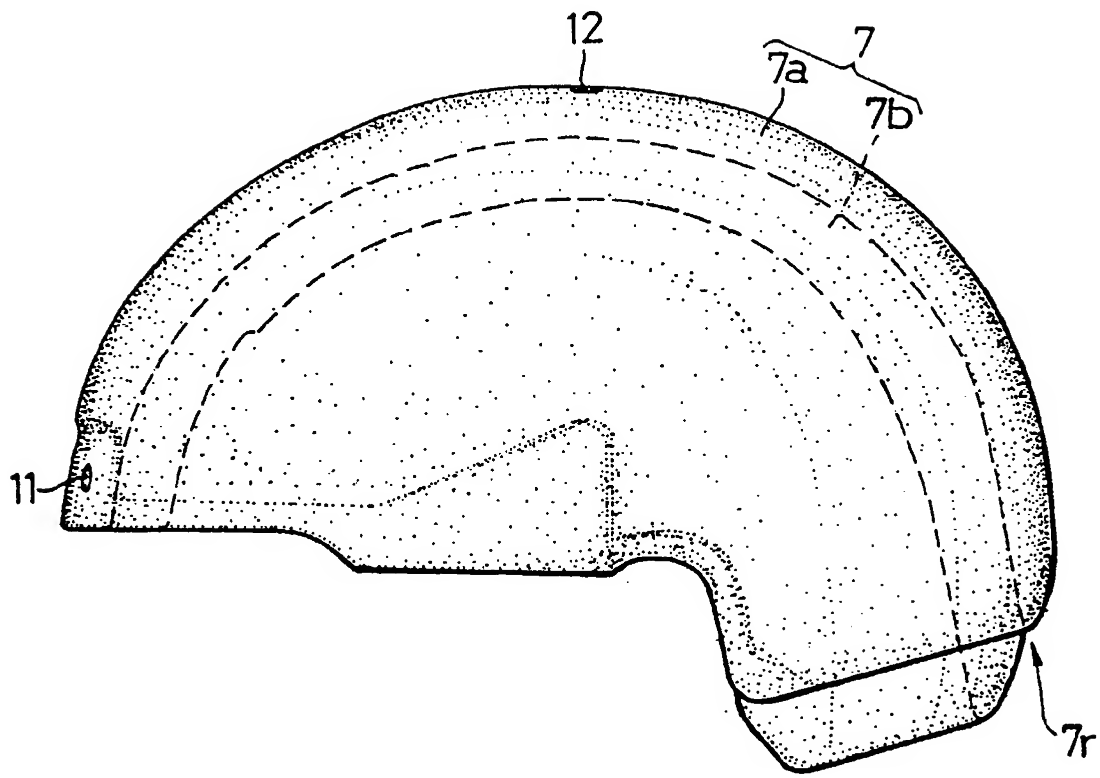


FIG.10

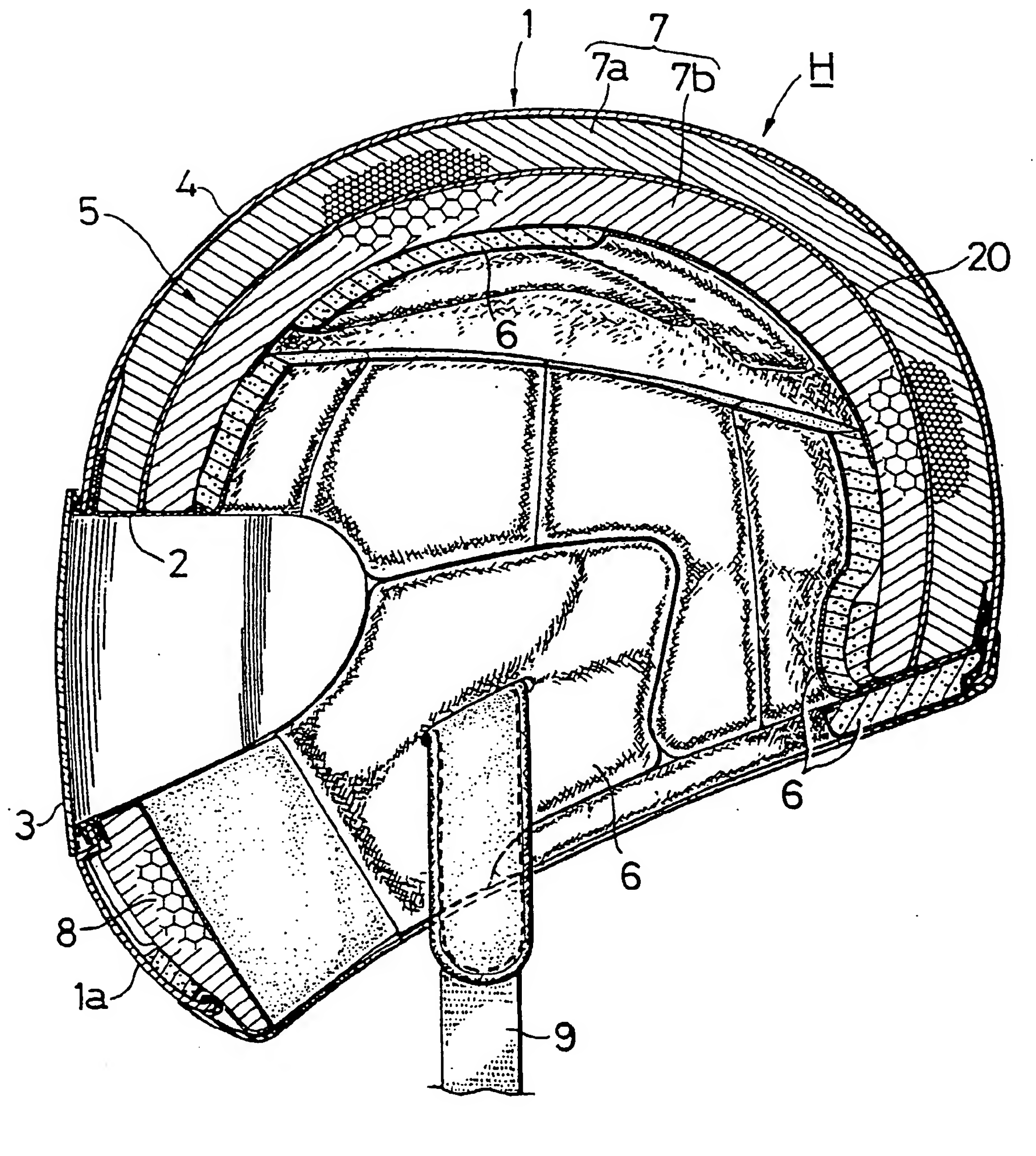


FIG.11

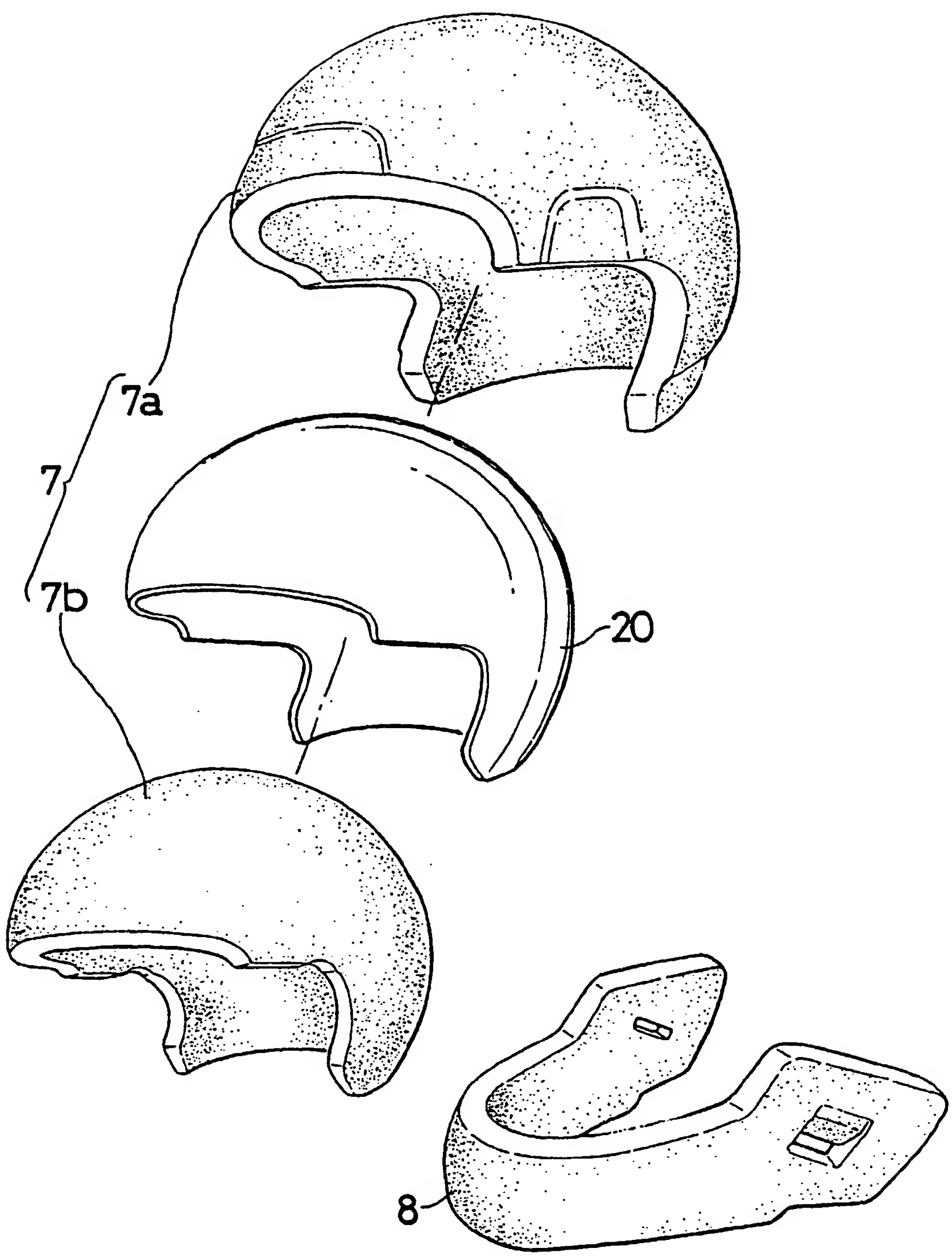


FIG.12

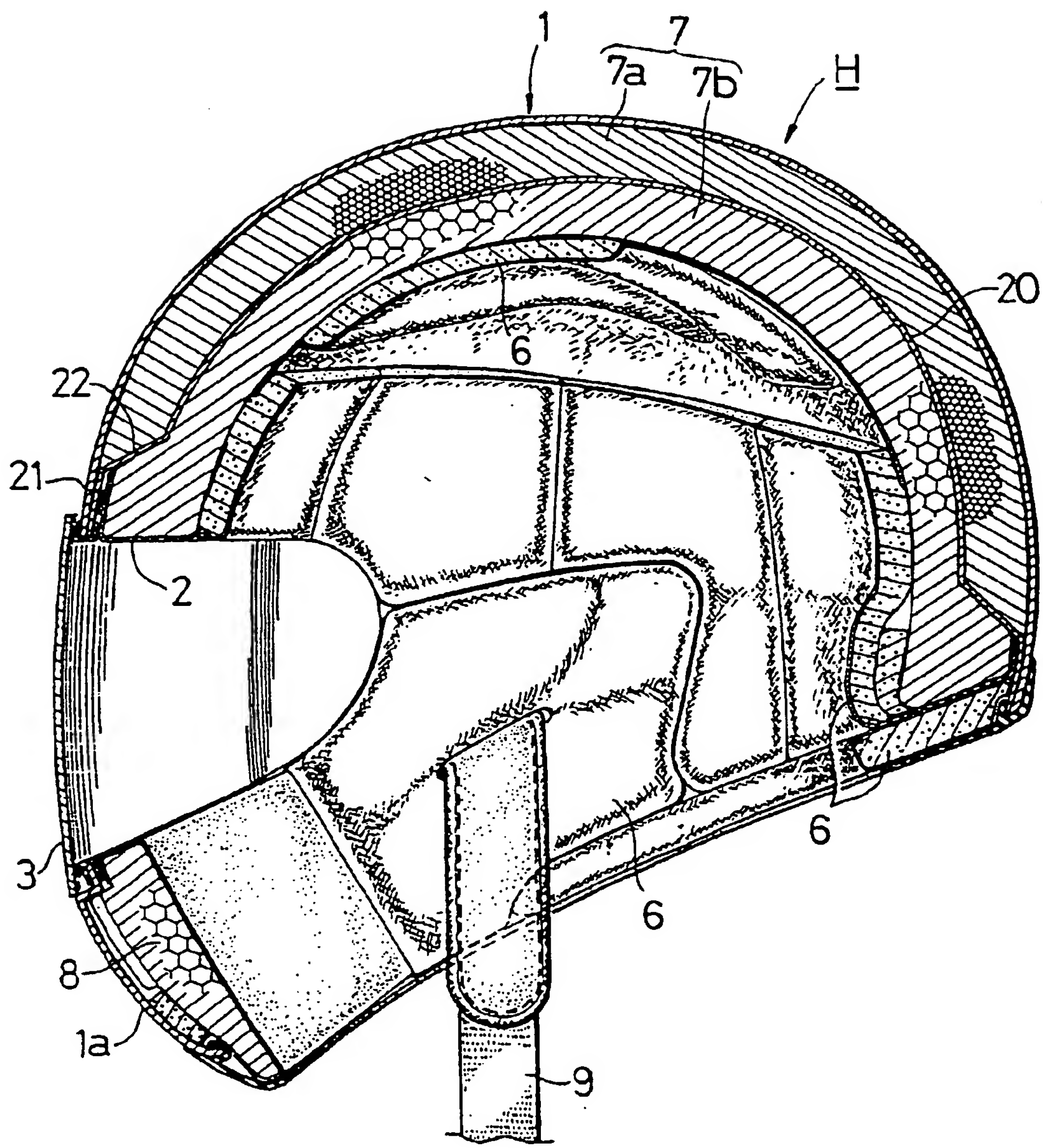


FIG.13

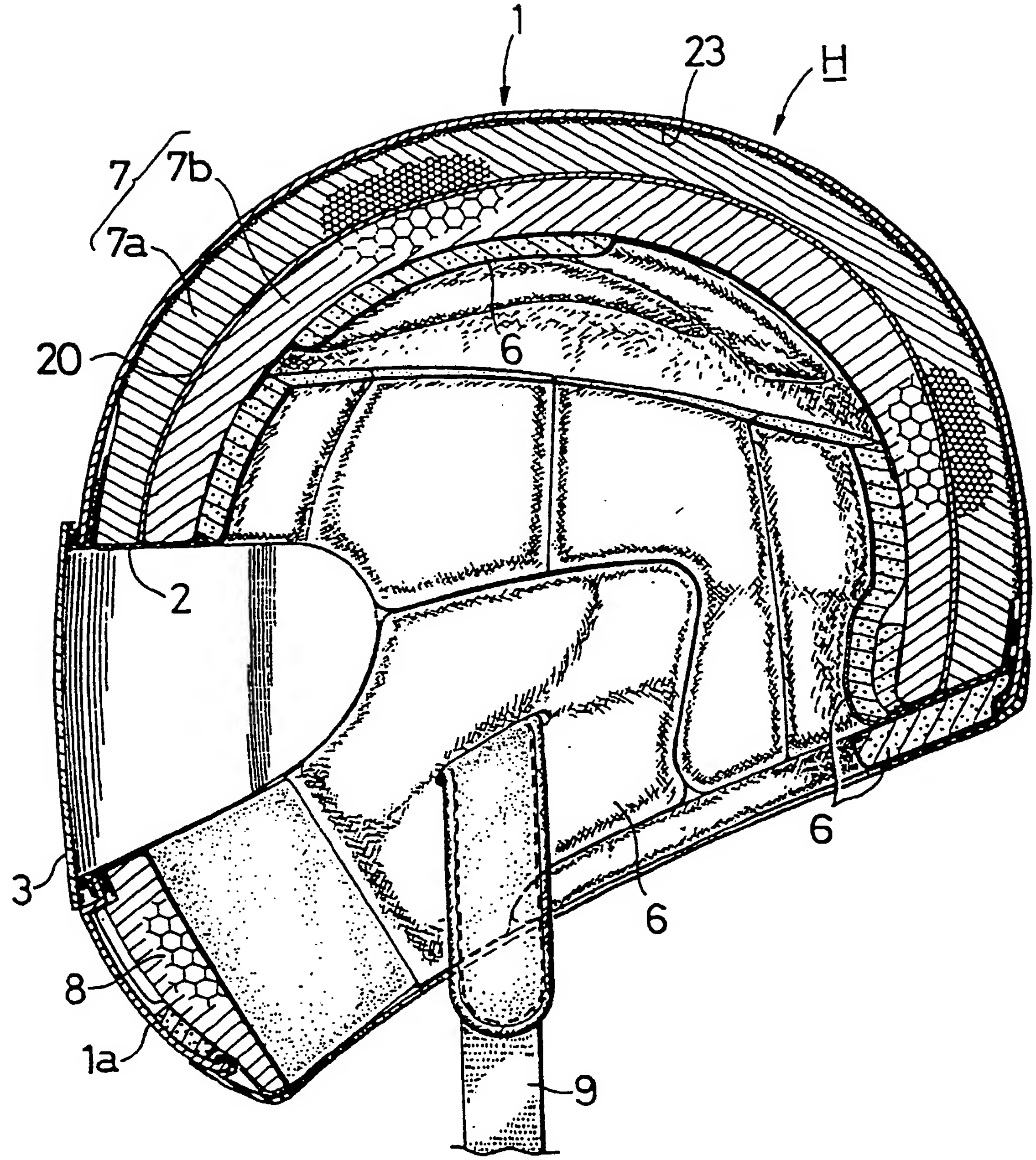
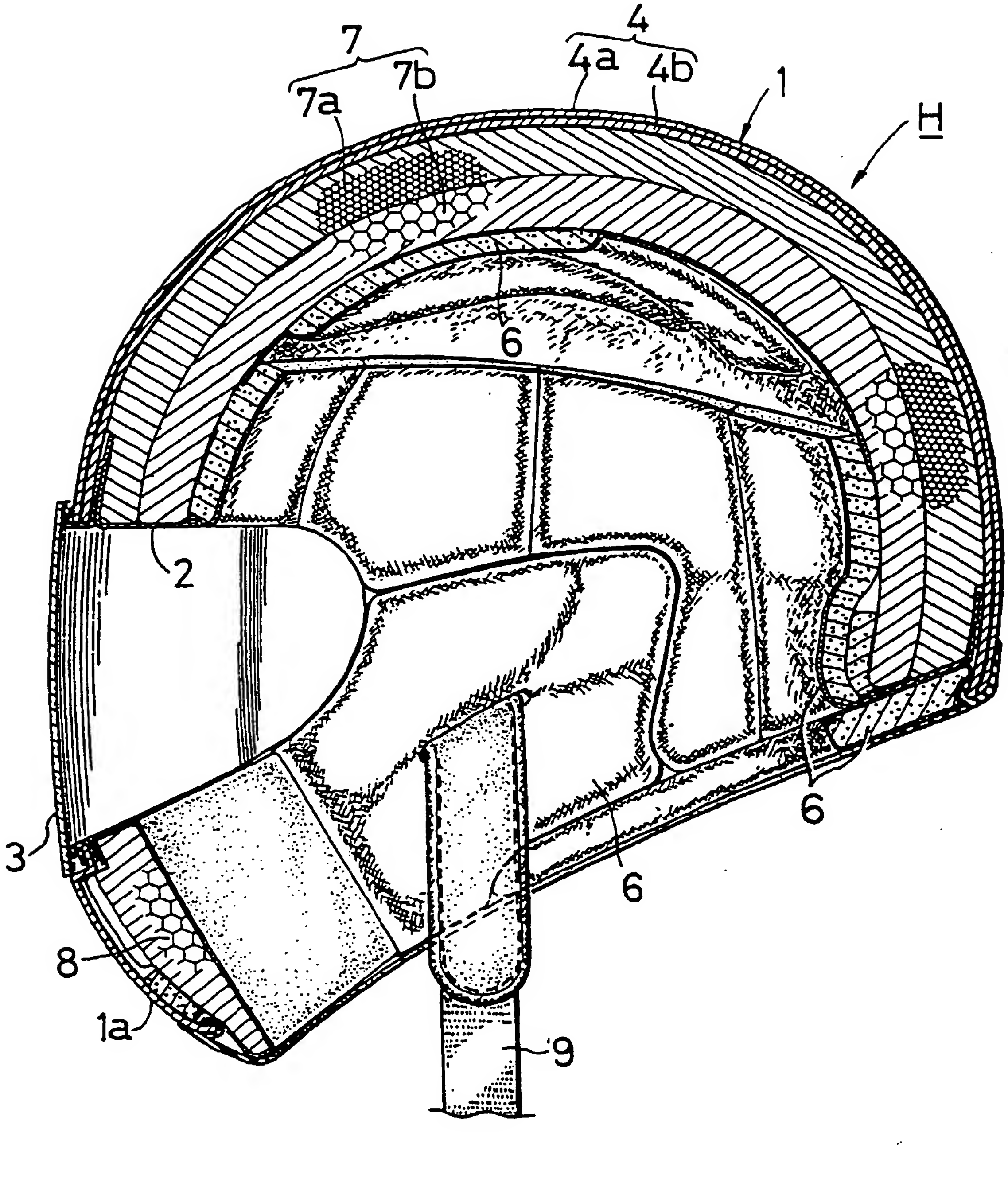


FIG.14



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 30 7674

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	DE 29 41 019 A (UVEX WINTER OPTIK GMBH) * page 4, paragraph 2 * * page 5, paragraphs 1 - 3 * * page 6, paragraphs 1, 2 * * page 7, paragraphs 1, 2 * * claims 1-3,8-12; figures 2,3 *	1	A42B3/12 A42B3/06
A		2,3,5, 10-14	

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	17 February 1997	Bourseau, A-M

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Application Number
EP 96 30 7674

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
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The present search report has been drawn up for all claims

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